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(71) Applicant

Mediscus Products Limited

(Incorporated in the United Kingdom)

44 Davies Street, London, W1Y 2BL, United Kingdom

(72) Inventors

John Barton

John Tracey Scales

(74) Agent and/or Address for Service

Brookes & Martin

**High Holborn House, 52-54 High Holborn, London,
WC1V 6SE, United Kingdom**

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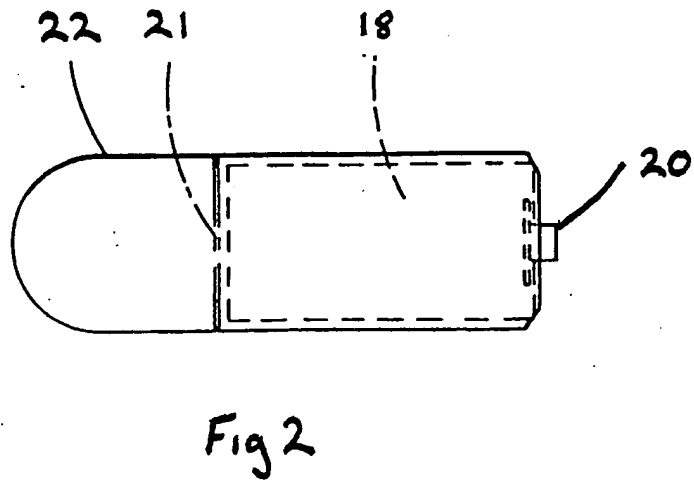
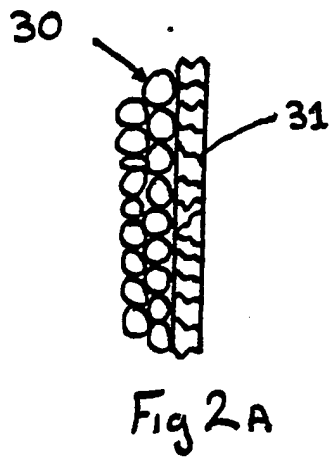
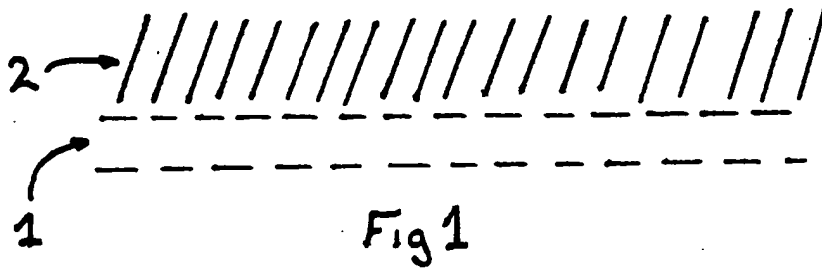
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(54) **Mattress or cushion having biocidal cover**

(57) A mattress or cushion cover is provided in which the cover comprises a sheet material which is permeable to water-vapour but substantially impermeable to liquid water, said sheet material having a bacteriostat or bactericidal substance incorporated within the material or contained in a coating on the inner surface.

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MATTRESS OR CUSHION HAVING BIOCIDAL COVER

This invention relates to a mattress or cushion having a biocidal cover and to covers for such use.

It is a constant problem, particularly in the environment of hospitals and nursing homes, to maintain a high degree of hygiene and sterility in mattresses and cushions in order to prevent cross-infection when beds are used by successive patients. Current procedures involve the use of disposable mattress covers or waterproof mattress covers which are washed with disinfectant before a bed is occupied by a new patient. The former solution is expensive, while the second does not always maintain bacteriostatic conditions within the cover.

A further measure which is sometimes taken is to subject covers to auto-claving in order to destroy the bacteria by heat sterilisation. Apart from being an expensive and laborious procedure, some materials do not easily withstand the temperatures involved in auto-claving treatment or are degraded by such treatment so that their useful life is shortened. Moreover, autoclaving does not guarantee that sterile conditions can be maintained over a sufficient period of use.

According to one aspect of the present invention, there is provided a mattress or cushion wherein the cover comprises a sheet material which is permeable to water-vapour but substantially impermeable to liquid water, said

sheet material having a bacteriostat or bacterial substance incorporated within the material or contained in a coating on the inner surface.

The invention is based on the realisation that bacteria tend to migrate from an area of initial infection on droplets of water and/or microscopic particles of dust. When a person is resting in a bed, moisture from perspiration and other body fluids becomes trapped between the body and the supporting surface. In cases where the mattress or pillow cover is water-vapour permeable, water-vapour passes through the cover to the interior because the water-vapour pressure is higher on the outside surface in the region between the patient and the surface, thus making the patient more comfortable. As water-vapour permeable fabrics or materials can be microporous, it is thought that bacteria will be carried through the fabric of the cover and this would lead to a spread of infection throughout the mattress or pillow. By incorporating a bacteriostat or bactericidal substance in the fibres of the fabric and/or in a coating on the inside surface of the cover, the pathogens can be controlled and the infection confined. As a result, conventional washing of the outer surface or autoclaving of a mattress or pillow cover in accordance with the invention will enable cross-infection to be totally controlled. Another important advantage is that since the bacteriostat or bactericidal

substance is contained within the fabric or in a coating on the inner surface, removal of the bacteriostat or bactericidal substance by surface abrasion or topical washing is much reduced since it is protected within the fabric or in the inner coating. Furthermore, incorporation of the anti-microbial agent within the cover or in a coating on its inner surface reduces the incidence of an allergic reaction arising from contact with the anti-microbial agent.

While a variety of anti-microbial substances may be employed for incorporation into the fibres, it is advantageous to select anti-microbial substances which are substantive to the fibres, and are therefore resistant to removal by laundering. One type of preferred biocidal fibres are ones in which an inorganic bacteriostat such as zinc oxide and/or silver oxide is incorporated in the fibre during its manufacture. Preferably, the biocidal agent is incorporated in the fibre with a zeolite, which is believed to assist in firmly attaching the biocidal agent to the fibre. Zeolites are hydrated alkali aluminium silicates having a highly porous structure.

Other suitable bacteriostat or bactericidal materials, especially for incorporation in a coating on the inner surface of the cover, include a trialkyl tin sulphasalicylate or N-trichloromethylthio-4-cyclohexene-1,2-dicarboximide, (available from R.T.

Vanderbuilt Inc. of Norwalk, Conn, U.S.A., under the trade mark Vancide). Other bacteriostat or bactericidal substances include hexachlorophene, chlorophenols, such as 6-chloro-2-phenyl phenol and Actmer biocidal agent available from Monsanto Chemical Co.

The mattress cover may be fitted over a core comprising a block of resilient, open-celled foam such as described in British Patent Nos. 2132083 and 2105,584. The mattress may be "self-ventilated", in that the movement of a patient on the mattress causes water-vapour, passing into the interior through the water-vapour permeable cover to pass through the foam and to exit through a porous panel at the base, e.g. as described in British Patent No. 1,596,157. Because the cover is water-vapour permeable, such movements cause water-vapour to pass through the cover from the vicinity of the patient's body, and to pass out of the mattress through the sides or the base, e.g. through air passages formed in the foam. It is believed that this "pumping action" may cause bacteria supported on droplets of moisture or dust to be carried into the mattress cover where the biocidal or anti-microbial substance neutralises the bacteria, either within the fabric or in the coating on the inner surface. While not wishing to be bound by any particular theory, it is believed that, where present, the zeolite attracts particles of dust which are generally electrostatically

charged and the zinc oxide and/or silver oxide or other biocidal agent kill the bacteria which are supported on the dust particles. In cases where bacteria are present in droplets of moisture, the water-vapour permeable material channels the bacteria through the membrane with the water vapour, whereupon the biocidal substance kills the bacteria.

The mattress core need not be of foam and may alternatively include springs or horsehair or other fibres.

Another method of enhancing the bactericidal effect is to weave the biocidal fibres into a fabric having a construction such that water droplets are wicked down into contact with the biocidal component of the fabric. This may involve weaving or knitting a hydrophilic fibre, e.g. cellulosic fibres into the fabric to enhance the wicking of the water droplets. Further details of such a construction will be given hereinafter in this specification.

The term "mattress cover" in this specification is used in a broad sense to include not only mattress covers of the traditional kind, e.g. as described in the above-cited British Patents Nos. 1,596,157 and 2,132,083, but also the covers of inflatable mattresses, e.g. of the kind in which a mattress is divided into compartments which are subjected to alternating pressure and also inflatable sacs

of low air loss beds, e.g. of the kind described in U.K. Patents Nos. 1,341,325, 1,474,018 and European Patent No. 0,034,954. In low air loss bed sacs there is a constant flow of air through the sac which sweeps away air which is laden with water vapour and which permeates through the water-vapour permeable membrane from areas in contact with the patient. In its passage through the water-vapour permeable membrane of the sacs, bacteria are brought into contact with the biocidal components of the membrane or cover.

In the case of alternating pressure inflatable mattresses, e.g. of the kind described in British Patents Nos. 1,595,417 and U.S. Patent No. 4,391,009, air flow is much reduced in comparison with the low air loss bed. Nevertheless, the alternating pressure would tend to cause moisture to pass to some extent through a water-vapour permeable fabric mattress cover. Accordingly, the covers or envelopes of alternating pressure mattresses may, with advantage, be constructed in accordance with this invention.

Preferably, the biocidal fibres are a polyester, polyacrylamide or polyacrylonitrile fibre which is not hydrophobic and has sufficient temperature resistance for auto-claving. The biocidal substance is preferably supported on zeolite and incorporated in finely-divided form in the spinning solution which is fed to the

spinnerette. There is no critical minimum limit for the amount of zeolite composition containing the biocidal material but, preferably, this should be not less than about 20% by weight and may be up to 50%. The concentration of the biocidal substance depends on the particular substance selected. Typically, it may be 0.5 to 5%, preferably 0.5 to 2% by weight. The biocidal fibres may be mixed with other fibres in the construction of the fabric but preferred material will contain at least 20% of biocidally active fibres. One specific example of a procedure for incorporating a biocidal substance in fibres or into film to be coated onto fabric is described in U.S. Patent No. 3, 284,395. As described in the U.S. patent, a coating or spinning composition is prepared by adding about 5% by weight of a biocidal agent to a solution of a polymer of acrylonitrile.

As indicated above, the mattress may have a central core of foam and may be self-ventilated. However, the mattress may include forced-ventilation, e.g. generated by an air blower as described in British Patent No. 1,443,759.

The biocidally active fibres may be woven together with a base fabric which is then coated with a water-vapour permeable membrane, e.g. a polyurethane coating or a silicone rubber membrane such as described in British patent No. 1,341,325. Alternatively, the fabric may be

coated with a hydrophilic polymer which on curing is water-vapour permeable as described in British patent No. 2,074,093. Alternatively, the water-vapour permeable membrane may be laminated to a woven or knitted fabric containing the biocidally active substance. The fabrics may be knitted or woven. Water-vapour permeable materials which are useful in the practice of this invention have a permeability of at least about 230g/sq metre/24 hours at 37°C. Fabrics having substantially higher water vapour transmission rates may be employed, e.g. having a permeability greater than 1000g/sq metre/24 hours. Permeabilities greater than 2000g/sq metre/24 hours are possible. However, the fabric should be waterproof in contact with liquid water under a hydrostatic head of at least 250 mm of water (normally 1000 mm hydrostatic pressure) for at least 30 minutes when carrying out the test described in British Patent No. 2,024,100. Water-vapour permeable fabrics are commercially available under the trade marks "Gortex" (from W.L. Gore & Assoc. Inc., Newark, Delaware, USA) and "Permatex" (from Carrington & Dewhurst Performance Fabrics). Currently preferred water-vapour permeable fabrics are produced by coating a woven or knitted fabric, preferably of polyamide, polyacrylic and/or polyester fibre, with a waterproof polyurethane layer. The polyurethane can be modified so that on curing it has a

microporous structure through which the water-vapour may pass. Polyurethane coating materials can be modified by including a hydrophilic polymer component. Such coatings are "chemically" porous towards water but not generally physically microporous. An example of a commercially available coating material of this kind is "Witcoflex Staycool" supplied by Baxenden Chemical Co. of Droitwich, Worcester, United Kingdom. This coating material is not, however, totally impermeable to bacteria and a biocidal substance may be incorporated in the coating.

In the case where a biocidal substance is incorporated in the water-vapour permeable (w.v.p.) coating, this is conveniently done by mixing it into the coating composition just prior to spreading it on the base fabric. The concentration of the biocidal agent in the coating composition may be from about 0.5 to 5% by weight, e.g. 0.5 to 2%. Any suitable coating equipment may be used, e.g. a knife coater, set to deposit a thin coating on the surface which will form the inner surface of the mattress. Of course, both sides can be coated but generally it is sufficient to coat only one. A coating weight is selected which will deposit a layer which is thinner than the base fabric. Typical coating weights are 5 to 20 g per square metre to yield a final cured w.v.p. layer of about 25 to 200 μm , preferably 50 to 100 μm . Curing is usually carried out by heating to about

175°C.

It is also desirable to include a fire-retardant substance into the fabric. This may be achieved by spraying the base fabric with a solution of the substance or by including it in the w.v.p. coating composition. Examples of suitable fire-retardant substances are "Proban 210" marketed by Albright & Wilson Limited and "Pyrovatex CP" supplied by Ciba-Geigy Limited.

Especially in cases where the cover is intended for enclosing a foam plastics core or base, the fabric from which the cover is constructed is preferably a two-way stretch material. In order to conform snugly to the foam plastics base, the fabric should extend by at least 30% in the width direction and at least 10% in the length direction when measured using a 3kg load in accordance with the test described in British Patent No. 2,105,584.

The attached Figure 1 illustrates typical laminates from which covers in accordance with the present invention may be manufactured.

Referring to Figure 1, reference numeral 1 indicates a water-vapour permeable membrane which may be formed by one of the procedures described in the above cited British patents. One commercially-available water-vapour permeable film material is sold under the trade name "Platilon". Other materials are generally available on a woven backing fabric, e.g. of polyamide or polyester. The

water-vapour permeable membrane is laminated to a fabric (2) which contains the biocidal fibres. This fabric may be woven or knitted. In one embodiment a knitted terry fabric with an upstanding pile is advantageous. This is because the pile can be used to wick moisture down into the fabric for intimate contact with the biocidal fibres. In this embodiment, the knitted terry fabric preferably has biocidal fibres forming the scaffold.

The biocidal fibres (which are normally polyester), may be used alone or blended with other fibres, e.g. of polyester, to form yarns from which the fabric is woven or knitted. The water-vapour permeable (w.v.p.) layer 1 can be laminated to the fabric 2 by calendaring the composition from which the w.v.p. layer is formed onto the biocidal fabric 2. Alternatively, the w.v.p. membrane may be preformed and then laminated to the biocidal base fabric.

Figure 2 shows diagrammatically in cross-section a cushion of a low air loss bed. The cushion is shaped to extend widthwise of the bed and arranged together with other similar cushions to form a patient supporting surface. For further details of the construction of low air loss beds, reference may be made, for example, to British Patent No. 1,474,018 and US Patent No. 4,525,885. an inlet 20 is provided for connection to an air supply and provision is made for air to exhaust from the cushion

at one or more other points in order to create an air flow through the interior of the cushion. The resulting air change maintains a water-vapour pressure within the cushion which is less than that at the contact area between the patient and the support surface. The cushion may include a shaped foam block 18 so that when the cushion is deflated, the patient is supported on a foam base. However, we currently prefer to employ cushions without foam interiors. Reference numeral 21 indicates a strap arranged to prevent the foam block being displaced.

Figure 2A is a view on an enlarged scale of part of the membrane forming the cover of the cushion. As can be seen, the membrane comprises a close-woven fabric 30 on the outside of the cushion and an adherent w.v.p. coating 31 on the inner surface. Coating 31, in this embodiment, is microporous but as explained above, the water-vapour permeability characteristics may derive from the inclusion of hydrophilic comonomers in the polymeric coating. Anti-microbial characteristics are imparted to the membrane by including biocidal fibres in the fabric 30 and/or a bacteriostat in the polymeric coating 31.

CLAIMS:-

1. A mattress or cushion wherein the cover comprises a sheet material which is permeable to water-vapour but substantially impermeable to liquid water, said sheet material having a bacteriostat or bactericidal substance incorporated within the material or contained in a coating on the inner surface.

2. A mattress or cushion according to claim 1 wherein the sheet material comprises a woven or knitted stretch fabric wherein at least some of the fibres are biocidally active.

3. A mattress or cushion according to claim 1 or claim 2 wherein the sheet material comprises a woven or knitted fabric which is coated on the inside with a water vapour permeable coating which contains a bacteriostat or bactericidal substance dispersed therein.

4. A mattress or cushion according to any one of the preceding claims wherein the water vapour permeability of the cover is at least 250 g/sq metre/24 hours at 37°C.

5. A mattress or cushion according to any one of the preceding claims wherein the sheet material is a two-way stretch fabric.

6. A mattress or cushion according to any one of the preceding claims wherein the cover also includes a fire-retardant substance.

7. A mattress which comprises an open-cell foam

base and a cover over said base, the cover comprising a water-vapour permeable sheet material which is substantially impermeable to liquid water but has a water vapour permeability of at least 250 g/sq metre/24 hours at 37°C, said sheet material incorporating a bacteriostat or bactericidal substance and/or having a biocidal coating containing a bacteriostat or bactericidal substance on its inner surface.

8. A mattress according to claim 7 wherein the biocidal coating is a water vapour permeable polyurethane coating.

9. A mattress according to claim 7 or claim 8 wherein the cover is comprised of stretch material having an extension of at least 20% in a first direction and at least 10% in a second direction at right angles to the first as measured according to British Standard 4294 using a 3 kg load.

10. A mattress according to any one of claims 7 to 9 wherein the fabric is treated with a flame retardant prior to application of the biocidal coating.

11. A low air loss mattress comprising a plurality of inflatable air sacs arranged to provide a patient supporting surface, wherein the material of at least some of the sacs comprises a water vapour permeable fabric which is substantially impermeable to liquid water, said fabric including a bacteriostat or bactericidal substance

incorporated therein and/or having a biocidal coating containing a bacteriostat or bactericidal substance on its inner surface.

12. A low air loss mattress according to claim 11 wherein the biocidal coating is a polyurethane coating having a bacteriostat or bactericidal substance dispersed therein.

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Relevant Technical fields

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(ii) Int Cl (Edition ⁵) A47C, A61G

Databases (see over)

(i) UK Patent Office

(ii) WPI

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Documents considered relevant following a search in respect of claims 1-12

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
	None	

SF2(p)

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Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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